

and a SAP channel. Information on audio scrambling techniques was added to the List of Attributes.

2. Given that a dynamic zone plate test signal be used for testing dynamic resolution, it was determined that qualitative as well as quantitative assessments of the effect on the image be included.
3. For testing compatible systems, the FCC Regulations, Part 73 should be applied as appropriate.
4. To provide a signal source of the highest quality MTF, and having no lag, a special scanning technique applied to the Showscan system appears to be a suitable choice.
5. In testing any proponent system, sample IDTV receivers of the latest type should be used. The List of Attributes was amended to include "IDTV Receiver Compatibility."
6. Only un-enhanced and normalized video materials should be used for testing. In the case of camera generated images, "normalization" means that camera images be made to match electronically generated images as closely as possible. In addition, no images should be used for testing in which the noise component has been electronically reduced.
7. Recognizing the difficulty of obtaining MTF data without obtaining internal signals from proponent equipment, it was determined that indirect methods be used to quantify chroma response. The value to be measured is the smallest object that can be reproduced in color.
8. Two items were added to the List of Attributes:
  - 1.4.1 The performance of ATV systems which have been spatially or temporally prefiltered, including the use of motion detection.
  - 1.4.2 The performance of ATV systems in response to input signals having random noise, clock noise, etc., superimposed on them.

Beyond the original scope of work, field testing was considered, and it was determined that it was desirable to have more than one field test site. The List of Attributes was amended to include under Transmission Field Testing:

- 6.9.1        At least one location exhibiting an average amount of difficulty, and,
- 6.9.2        At least one location considered "difficult."

It was further noted that there are no plans to conduct field tests in the low-band VHF spectrum. Broadcasters in the Working Parties assert that transmission field tests should be conducted in both the VHF and the UHF bands.

In all, eight additions or amendments were made to the List of Attributes.

**B.     Progress Report of Working Party 3:   Spectrum  
         Utilization and Alternatives**

As described below, PS/WP-3 has made several important contributions in the past twelve months. Among other things, the Working Party inaugurated a multi-faceted study of the extent of, and means for accommodating, ATV distribution and contribution capacity requirements. In addition, the Working Party further analyzed the relationships among various taboos and the degree to which these constraints might affect the number of existing broadcast stations accommodated under an ATV channel plan. Finally, the Working Party has also made

progress in developing ATV planning factors and, in response to an inquiry from the Systems Subcommittee, developed a qualitative list of spectrum-related characteristics that a preferred ATV transmission system would possess.

#### **1. Broadcast Auxiliary Capacity**

The Specialist Group dealing with broadcast support spectrum issues made progress in four areas:

First, critical issues were identified concerning the need for additional non-broadcast spectrum to support the deployment of a terrestrial ATV broadcast service. If, for example, the NTSC and ATV signals being simulcast are not identical or are distributed as separate NTSC and ATV formats, substantially more capacity could be required for contribution (e.g., ENG links) and distribution (e.g., STLs) circuits.

Second, proponents were solicited for their comments on the impact of their systems on the contribution and distribution systems used by broadcasters.

Third, a study was conducted of the impact of ATV broadcast support spectrum in North Carolina, representing the situation in the smaller markets. It was determined that, while each station could be provided with an additional STL channel to carry the ATV signal, higher performance antennas would be required.

Fourth, possible new spectrum was reviewed for ATV broadcast support services, and this study is fully reported in the attached PS/WP-3 report (Appendix C).

## **2. ATV Channel Availability**

Specialist Groups 6 and 7 have made further studies of the relationship between ATV channel availability and receiver taboos under various scenarios. Several preliminary findings have emerged from this ongoing work, as follows.

The maintenance of large adjacent channel separation distances, similar to that which exist today, would appear to produce the biggest single constraint on the availability of ATV channels. Consequently, fewer stations might receive an ATV channel if the new transmission system cannot co-exist adequately with adjacent channel NTSC stations.

On the other hand, other off-channel assignment restrictions, especially those related to intermodulation interference, are much smaller. Accordingly, the effect on the availability of ATV channels of maintaining some of these is relatively small. Moreover, except for the picture image taboo, the effect of increasing or decreasing the taboo separation distance has little or no impact on the accommodation statistics.

It was also discovered that the greatest number of existing stations could be assigned an ATV channel if ATV and

NTSC facilities were co-located. Furthermore, exact co-location would appear to offer the greatest benefit in this regard.

### **3. Planning Factors**

Specialist Group 10, concerned with the planning factors necessary to determine the basic service areas for ATV, continued its work. Starting with the existing NTSC Channel Allotment Plan, the Group has begun to identify and modify the factors, taking into account the new information on ATV channels and systems.

The Specialist Group also assisted SS/WP-4, by providing guidelines on how to judge the spectrum-related aspects of particular ATV systems. In addressing this issue, it was recognized that a computer program allowing the rapid preparation of graphical representations of interference-free service areas under a variety of geographic spacing and power/antenna height combinations would be valuable. The Zenith Corporation has developed a program for this purpose and offered its cooperation in refining the software for use by the Working Party.

**C. Progress Report of Working Party 4: Alternative Media Technology and Broadcast Interface**

Following the earlier work of PS/WP-4 in developing the concept of the "multiport" receiver, substantial progress has been made by the Electronic Industries Association ("EIA") and the Advanced Television Standards Committee ("ATSC") in addressing interoperability issues between the alternative media. These two groups have proposed three basic structures that will provide receiver manufacturers, television service providers, and consumers with standardized interfaces that can have various levels of performance and complexity.

In the course of this work, it has become apparent that ambiguous new terms have evolved in the ATV proceedings. Most importantly, the widely used term "ATV receiver" is now defined to consist of three components:

- A tuner/demodulator which yields non-carrier protocols
- An interface processor which will accept and process non-carrier signals from broadcast and alternative media, and
- A display device.

PS/WP-4 also has found that conditional access is a relevant attribute of an ATV transmission standard. Issues concerning this attribute requiring further study by appropriate organizations include: anti-taping mechanisms, consumer addressability, provision for "service on demand",

service tiers, universal access system, and, a "blackout" feature whereby real-time viewing can be disabled on a geographic region basis.

Much of the work of PS/WP-4 has been completed, and several organizations have initiated follow-up activities. It is believed that the interoperability concepts, test plans and definitions developed previously remain applicable in the digital domain.

**D. Progress Report of Working Party 5: Economic Factors and Market Penetration**

During the fourth period of work, PS/WP-5 concentrated on refining its receiver penetration estimates and appraising the cost to local broadcast stations of establishing a simulcast ATV service.

The new set of receiver market penetration scenarios was developed based on a set of modified assumptions, including an estimate of the price elasticity of ATV receivers, cost reductions driven by global economies of scale, and the assumption that Europe and Japan could introduce ATV service

before the U.S.<sup>3</sup> The new penetration scenario posited that the ATV receiver penetration will be five percent five years after the introductory one percent point has been achieved, and 30 percent after ten years.<sup>4</sup>

In the latter part of the work period, important new considerations have led to a further revision in the

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<sup>3</sup> In addition, a more detailed review of the validity of the historical models which had been used as a guide to market penetration was conducted. It was found that the models of color TV and the VCR were flawed in that they did not adequately represent the market environment in which ATV service would most likely be introduced in the U.S. Thus, the penetration of color TV in the introductory period was significantly constrained by the lack of color programming, and the VCR at its introduction was used mainly for time-shifted viewing of broadcast TV programs, there being a general lack of different programs available on cassette.

<sup>4</sup> Firstly, feature films produced on 35mm Film, are in fact high definition, and they can be readily transferred to the HD format for broadcast. Equally, virtually all television drama and movies-of-the-week, constituting 70 percent of prime time programming, are also shot on 35mm film, and these too can be transferred to the HD broadcast format.

For the remaining programs that have been produced electronically in the current 525-line NTSC format, the NTSC signal may be "up-converted" to the HD format, and broadcast on the simulcast channel, much as synthesized stereo audio has been used in the introduction of full stereo audio television service. This option however, results in a black curtain at each side of the 4:3 aspect ratio picture.

A second option, which is appropriate when local origination is required, is to shoot studio productions with a 525-line camera adapted for a 16:9 aspect ratio lens and recorded on a 16:9 aspect ratio VTR. This signal would then be broadcast on the simulcast channel, while a narrow screen down-conversion would be broadcast on the NTSC channel.

While neither of these options provides true High Definition, subjectively they will be superior to NTSC, and will serve as an interim measure during the introductory period of HD penetration.

penetration estimates. The most important technical development is the broad emergence of all-digital transmission systems. One important consequence of these systems, uncovered in independent studies submitted to PS/WP-5 by CBS and PBS, is that the anticipated cost of transition to ATV simulcast service will be much lower than previously projected. This fact should encourage stations to convert more rapidly.

Based on certain assumptions,<sup>5</sup> the CBS study projected that the first 30 stations to convert to ATV would incur capital and labor costs of approximately \$12 million over a five-year transition period. It is further projected that subsequent groups of stations, each twice as large as the previous group, would start the transition process in succeeding years, and would extend the period of conversion over longer periods. Thus, for stations in smaller markets, the annual capital investment would be reduced (less than \$8 million), and the actual cost of each phase of the conversion would be reduced through the economies of scale developed. The full studies of the transition scenarios developed by

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<sup>5</sup> The CBS analysis is founded on four general assumptions: 1) Stations in the largest markets will convert to ATV first; 2) The transition will take place in phases, and will extend over several years; 2) The ATV transmission system will require lower power than current NTSC transmission systems, and will use a smaller antenna; and, 4) Each doubling of HD equipment manufactured will lead to a 10 percent reduction in the prior cost.

both PBS and CBS are appended to the PS/WP-5 report (Appendix E).

Based upon the economic impact of new digital transmission technology, and upon the feasibility of providing a reasonably complete broadcast schedule on the ATV simulcast channel at the outset,<sup>6</sup> the Chairman of PS/WP-5 concluded that the second penetration scenario's upper and more optimistic bound now has greater validity. This upper bound projects a 10 percent penetration in five years, and a 40 percent penetration in 10 years, both terms being subsequent to the achievement of the introductory one percent penetration.<sup>7</sup>

#### **E. Working Party 6: Subjective Assessment**

During this period, the efforts of the Working Party were centered on one primary task -- that of producing the

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<sup>6</sup> Obviously, at the outset, much of the programming on the simulcast channels will not be electronically produced ATV material. Instead, as is the case today, the bulk of the primetime programming is expected to be 35mm film (inherently high definition), converted to the ATV transmission format.

<sup>7</sup> This initial penetration point could well be reached much earlier than was the case with color TV because improved quality programming can be made available at the introduction of ATV service. Moreover, it remains likely that ATV home video players and ATV cable service will in fact precede the introduction of ATV terrestrial broadcasting, and even seed the market to the one percent penetration point before the ATV terrestrial service is inaugurated.

high definition and NTSC video taped test materials needed for conduct of the FCC Advisory Committee's subjective test plans.<sup>8</sup> The task was mammoth, encompassing many man-years of effort and several hundred thousand dollars in cash and in-kind equipment loans. As is true for all Advisory Committee activities, this job involved many interested parties, each with particular viewpoints on various aspects of the task.

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<sup>8</sup> It is appropriate here to express the gratitude of the Working Party and the Planning Subcommittee to the proponents, test laboratories and broadcasters who made cash contributions to the production of the test materials; to thank the many companies who loaned valuable equipment to the effort, and to express gratitude to those who volunteered their expertise and in some cases, many, many weeks of labor away from their normal job responsibilities to make the technical complement of equipment work successfully.

Deserving of special commendation are Craig Tanner of CableLabs who served as Executive Producer of the test materials, Jim Gaspar of the Panasonic Advanced Television & Video Laboratory, who served as Technical Coordinator for the studio and exterior productions; and Paul Hearty of the Advanced Television Evaluation Laboratory in Ottawa, Canada, who served as Content Coordinator for the studio-based scenes. Thanks also to Alan Godber and Jay Ballard of NBC, who contributed substantial time and expertise. All those working on this project did so under conditions of extreme time and cost pressure. They successfully resolved many technical challenges never before met in any video production. Credit is also due Phil Crosby of Tektronix Corporation, for his early work on interfacing the Tektronix Format Converter to the Sony digital high definition video tape recorders to allow digital recording of the high definition video signals.

Thanks also to David Niles and the staff of Captain of America, the New York-based high definition production company contracted to do the production by the Working Party.

Although not every participant was completely satisfied with every aspect of the production effort, the Working Party has successfully completed production of the studio portion of the test materials, although some post-production editing is required before delivery to the Advanced Television Test Center and Cable Television Laboratories. It is expected that this material will be edited and ready for final delivery by March 22, 1991.

The Working Party has also successfully produced the "proponent" videotape materials, and they are presently being edited. These are ten 2-minute scenes intended for delivery to each of the ATV system proponents except Zenith and MIT, who did not participate in this phase of the production. This material is intended for laboratory use by the ATV system proponents in preparing their systems for test. The material consists of exterior shots around New York City in three of the high definition formats needed, and will provide a wide range of visual material for proponents' system testing, without compromising the integrity of the official subjective test material.

Finally, the Working Party, as part of the production of the studio-based video material, and with the cooperation of the Advanced Television Test Center, recorded in all five formats the mechanically-rotated dynamic resolution patterns needed for the objective testing of the proposed ATV systems.

Remaining on the Working Party's work schedule in the coming weeks are the final verification of the technical performance of the multi-format telecine system being built under contract to Zenith Electronics Corporation by Showscan Film Corporation and with the assistance of BTS, Inc. When this system is verified as having satisfactory technical performance, the four film segments, each 10 seconds in length, will be transferred to the four high definition video formats and to NTSC. These will include two scenes at 24 frames per second, one scene at 30 frames-per-second, and one 70mm scene at 60 frames-per-second.

Finally, the Working Party must complete the computer-based rendering of a single 10-second motion sequence and a single still image, and transfer the resultant digital image data to the four high definition video formats and to NTSC. AT&T Bell Laboratories is completing a final, detailed technical proposal describing this work, and PS/WP-6 expects to be able to give a go-ahead for the rendering work to begin at Bell Labs. Conversion of the master rendered image to the five required formats and the final recording of these images is expected to be completed by April 3, 1991.

**F. Progress Report of Working Party 7: Audience Research**

Since its last report, Working Party 7 has focused primarily on its new work statement in which the group was

called upon to: (a) seek financial support for proposed audience research program; and (b) develop a liaison with SS/WP-2 to assess possible synergies between their activities and those of PS/WP-7.

PS/WP-7 held a meeting on July 11, 1990 at NAB Headquarters in Washington, D.C. to discuss these items. Actions pursuant to this meeting have not been fruitful in terms of securing funding or in identifying meaningful ways in which WP-7 could develop a productive liaison with SS/WP-2 due to the fundamentally different goals and methods of the two working parties.

PS/WP-7 was also to have considered a study for evaluating audience responses to "letter box" television pictures (i.e., displaying a widescreen picture in an NTSC format in a fashion that leaves some form of bars at the top and bottom on the picture). Since the Advanced Television Test Center awarded a contract for this research, WP-7 sought to coordinate its interest with those of ATTC. Ultimately, this was not a productive path. Currently, the point is largely moot because none of the six proponent systems have indicated that they will employ a letter box solution and ATTC has therefore decided to cancel its work in this area.

In conclusion, it appears that while WP-7 was able to develop a comprehensive research program to investigate consumer reactions to advanced television systems, the

research cannot be executed due to lack of financial support forthcoming from industry, foundation, or government sources.

#### V. FURTHER WORK

A substantial portion of the responsibility assigned the Planning Subcommittee has been in making preparations for the testing process. In this regard, the Subcommittee has identified ATV attributes that should be assessed and specified the tests needed to make those assessments. In addition, the Subcommittee has created and produced the video material that will be used in making some objective and all subjective evaluations of ATV systems.

The Advisory Committee's program of system testing will commence soon. Consequently, one of the Planning Subcommittee's primary missions has been completed, and several of its component groups will be disbanded. To allow for re-activation if required, however, a few Working Parties will remain constituted in a "stand-by" mode. As discussed below, Working Parties 3, 5 and 6 will remain active.

##### A. Further Work of Working Party 1: Technology Attributes and Assessment and Working Party 2: Testing Evaluation and Specifications

The bulk of PS/WPs' 1&2 work is completed. However, because the test plans may require further refinement, the

working parties will remain constituted to provide support for this effort.

**B. Future Work of Working Party 3: Spectrum Utilization and Alternatives**

Over the remaining life of the Advisory Committee, PS/WP-3 will concentrate its efforts on three general tasks. First and most importantly, it will prepare for and conduct comparative evaluations of the coverage and interference characteristics of each ATV system.

In this regard, the Working Party has already articulated certain properties of a preferred ATV system. Among these are qualities which would allow for the assignment, to essentially all existing television stations, an additional ATV channel with coverage essentially equivalent to NTSC Grade B. The Working Party will undertake to propose such a channel assignment for ATV systems. The Working Party's spectrum evaluations will necessarily include an assessment of how well each system meets this objective. To conduct this evaluation, each system's planning factors must be finalized and the development of a computerized model for rating and presenting the comparative analysis must be completed.

A second important task of PS/WP-3 will be to conclude its study of broadcast distribution and contribution circuit requirements and options. Based on the results of this

study, the Working Party will strive to develop recommendations for consideration by the Advisory Committee and the Commission.

Finally, the Working Party will renew its coordination efforts with Canada and Mexico.

**C. Further Work of Working Party 4: Alternative Media Technology and Broadcast Interface**

PS/WP-4 has contributed meaningfully to the Advisory Committee's effort by ensuring both that the Committee's test plans assess adequately how well terrestrial ATV systems interface with cable media and that proponents are informed as to the special requirements of these media. Its work is essentially complete. No further work is planned beyond continued monitoring of ongoing work of other organizations. In light of the importance attached to the non-broadcast interface, however, PS/WP-4 will remain constituted to act in an advisory role as conditions dictate.

**D. Further Work of Working Party 5: Economic Factors and Market Penetration**

PS/WP-5 has done an outstanding job in conducting the macroeconomic analysis contemplated for the Planning Subcommittee. This work is essentially complete, and much of the economic study now being conducted is performed in coordination with Systems Subcommittee Working Party 3 that

has responsibility for estimating systems costs. PS/WP-5 will continue to refine its macro-economic analysis as new factual data becomes available, and it will begin work on its assignment to investigate the implications of ATV policies for industrial development and international trade.

**E. Further Work of Working Party 6: Subjective Assessment**

Once it completes working on the film transfers and electronically generated still video test material, Working Party 6 will have completed its primary assignment -- the design and creation of the motion and still video sequences used in the subjective and objective tests of ATV systems. However, a remaining and important incidental responsibility of the Working Party is the maintenance and management of the stock of specialists used to supply the expert viewer panels that will conduct some of the tests. Accordingly, PS/WP-6 will remain in an active status. The Working Party will work directly with the Planning Subcommittee Chairman to create and administer the expert viewer project.

**F. Further Work of Working Party 7: Audience Research**

Despite the outstanding effort PS/WP-7 has made in planning several market research efforts, funds have not been secured for these studies. Inasmuch as the information derived from these studies would have been of most benefit

earlier in the Advisory Committee process, it is concluded that there is little advantage in continuing the Working Party's activities. Accordingly, PS/WP-7 is disbanded.

**G. Further Work of Advisory Group 1: Creative Issues  
and Advisory Group 2: Consumer and Trade Issues**

Both of these Advisory Groups made important contributions in the first 18 months of the Advisory Committee's existence and helped set the stage for much of the progress the Committee has enjoyed. More recently, the involvement of these groups has been very limited, however. Inasmuch as economic issues are now being dealt with adequately in PS/WP-5 and SS/WP-3, it is concluded that Advisory Group 2 need no longer continue as a separate entity. Advisory Group 1 will remain constituted, however, to provide the Committee with a ready source of advice from the creative community.

**VI. CONCLUSIONS AND RECOMMENDATIONS TO THE ADVISORY  
COMMITTEE**

As is apparent from this report, the Planning Subcommittee has succeeded in completing much of its mission. Although other assignments may arise, at this point the only readily identifiable tasks remaining for the Subcommittee are the administration of the spectrum analyses and the management of the expert viewing panels. These are two

exceedingly important activities, and, as discussed below, their successful completion requires guidance and support from the Advisory Committee.

**A. Expert Viewing Panels**

Based on recommendations in the Planning Subcommittee's Third Interim Report, the test plan now calls for employing panels of expert viewers to establish thresholds and ranges of the various subjective impairments. Use of this approach ensures that, without sacrificing the quality of test results, the time and money expended on subjective testing can be reduced substantially from what otherwise would be required.

This method obviously requires enlisting un-biased experts. The FCC has agreed to contribute some staff to this effort, but a relatively large number of private sector experts will also be required. It is estimated that this project will require nearly 300 man-weeks of effort at the ATTC in Washington, DC, spread over a two-year period. The process of identifying these private sector candidates has begun, but an issue which has not been addressed explicitly, is the financial support of these experts in Washington. Hopefully, as has been the case for all the other Advisory Committee participants, the companies with whom these experts

are affiliated will donate the time and expense money required of their participating employees.

Many of the potential experts will undoubtedly come from firms and companies represented on the parent Advisory Committee. It is therefore envisioned that members of the blue ribbon panel will commit to supporting this effort. If, however, this support is not forthcoming, some other form of financing will have be found.

#### **B. Spectrum Goals and Analyses**

The Planning Subcommittee, through its Working Party 3, is playing an important role in quantifying the spectrum requirements of ATV systems. As reported above, PS/WP-3 has already outlined what it believes are desirable attributes of a preferred ATV system, including the ability to "fit" into the existing taboo structure in such a way as to provide essentially all existing broadcasters with a simulcast channel whose coverage characteristics are equivalent through the NTSC Grade B service.

The spectrum analyses are likely to present many tradeoffs. Every analysis of spectrum availability involves many computer "runs" each of which generates its own unique channel assignment plan. Insofar as a particular system is preferred in part because of its superior spectrum characteristics, it is planned to memorialize those

characteristics into a channel assignment plan that would be offered to the FCC as part of the ATV system recommendation. Therefore, the Planning Subcommittee Chairman recommends that the Advisory Committee endorse the goal of developing a detailed channel assignment plan for the ATV system it judges as preferred.

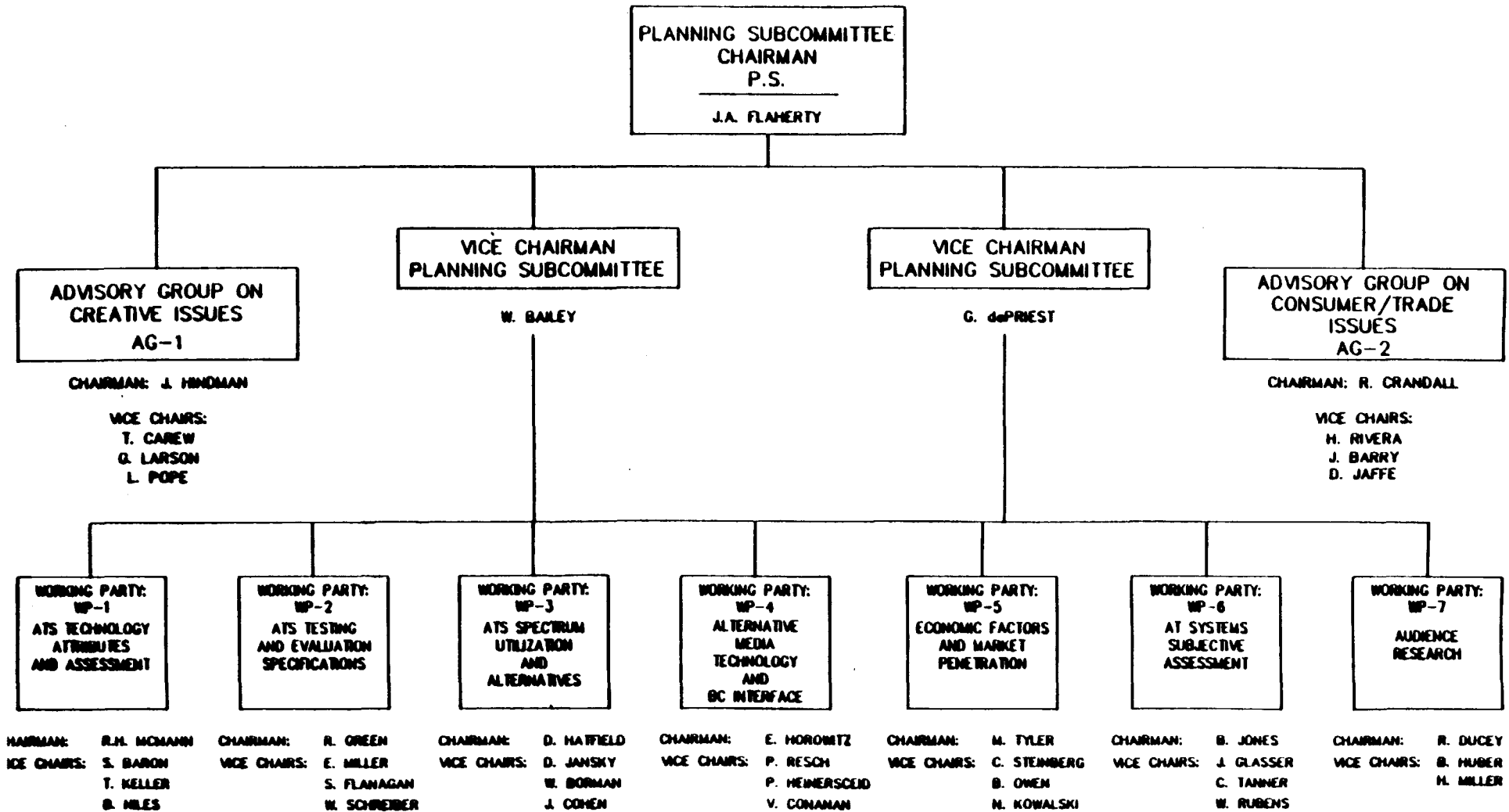
**VII. SUMMARY OF PLANNING SUBCOMMITTEE ACTIONS AND CHAIRMAN'S RECOMMENDATIONS**

The actions of the Planning Subcommittee and the recommendations of its Chairman are recapped below:

- Due to the completion of many of its duties, the Planning Subcommittee is terminating Advisory Group 2 and Working Party 7. Working Parties 1, 2, and 4 will remain constituted in a "stand by" mode. Working Parties 3, 5 and 6 will remain active.
- It is recommended that individual companies represented on the Advisory Committee's parent panel explicitly commit to support the funding for the expert viewers that will be used in testing ATV systems.
- It is recommended that the Advisory Committee endorse the goal of PS/WP-3 to develop an explicit channel assignment plan for the preferred ATV system.

FEDERAL COMMUNICATIONS COMMISSION  
ADVISORY COMMITTEE ON ADVANCED TELEVISION SERVICE

1/31/80



TAB

FOURTH INTERIM REPORT OF

WORKING PARTY 1

ON ATS TECHNOLOGY ATTRIBUTES AND ASSESSMENTS

and

WORKING PARTY 2

ON ATS TESTING AND EVALUATION SPECIFICATION

of the

PLANNING SUBCOMMITTEE

of the

ADVISORY COMMITTEE ON ADVANCED TELEVISION SERVICE

March 1991